SUPPLEMENT.

The Mining Journal,

RAILWAY AND COMMERCIAL GAZETTE:

FORMING A COMPLETE RECORD OF THE PROCEEDINGS OF ALL PUBLIC COMPANIES.

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THE NATIONAL IRON AND STEEL INSTITUTE

The annual conference of the members of the National Iron and Steel Institute, of which the Duke of Devonshire is President, has been held at Middlesborough. In no other town in England could such a gathering be held with more appropriateness. Middlesborough would be nothing but for iron and steel, and it is the centre of a district not mere famous for good agricultural land than for its mineral resources. Many of the members and visitors arrived on Tuesday; and, in anticipation of their presence, the quarterly meeting of the North of England Iron and Allied Trades took place in the Exchange, from eleven to one o'clock. It proved the most successful meeting that has been held since the inauguration of the association, two years ago. Like those which have preceded it, it was of the nature of a conversazione and exhibition. Many of the articles shown had all the attraction of novelties, and were inspected with the greatest interest and care. Amongst the models was a beautiful one of the screw-steamer Denmark, belonging to the National Steam Navigation Company; and another of the screw-steamer "Germany," belonging to Messrs. Allen and Co., of Glasgow. Both the vessels were built by Messrs. Pearse and Co., of Stockton, and it says something for the eminence of this firm that traders belonging to a river that is famous for nothing if not for shipbuilding, should have sent a commission all the way from Glasgow to the Tees. Messrs. Pearce and Co. also exhibited a model of a troop steamer for the Lower Indus, for the building of which they obtained the contract. This vessel was designed by Mr. T. B. Winter, C.E., of the Mining Institute. The hull has been built of Weardale puddled steel, and the length of the vessel over all is 375 feet; beam moulded 46 feet; breadth over paddle-boxes, 79 ft.; speed per hour, 13 miles; displacement, 739 tons; builder's measurement, 3910 tons; engines—nominal 220, and effective 800-horse power. Accommodation is provided in the vessel for 800 horses and men. A model of an improved railway crossing found many admirers. Mr. Truelove, of Sheffield, is the inventor. The crossing is adapted for either double-headed or flat-bottomed rails, and the advantages claimed for it are economy of cost, an easy repair of wearing parts, and reversibility of wearing parts. The pond or tongue is a solid crucible steel casting, the wing rails are of Bessemer steel, and are rolled to a half double-headed section, and are reversible. The foundation plate is a casting, and is bolted to parallel bars. Mr. Thomas Morgan, of Stockton, showed a model of a patent puddling machine, that works the iron and makes each ball to weight and size. In the same category were models of Hurmann's improvements in blast-furnaces. The principal features in these furnaces are the closing of the hearth on all sides, and in the running of the slag through the scoria outlet or "cinder-block." An interesting boiler model was shown, being E. Crowe's patent for applying waste heat from furnaces. The boiler consists of two horizontal tubes, 24 feet long, placed parallel, and one over the other; top tube with steam dome, 2 ft. 6 in. in diameter; bottom tube 2 feet in diameter. The two tubes are connected by nine vertical tubes 10 in. in diameter and 2 feet 9 in. long. The boiler is arranged in the form of a girder, giving stiffness, and is of simple construction. The end of the top tube and the opposite end of the bottom tube are fitted with man-holes, for access to inside of boiler. The boiler is encased in fire-brick work, which forms the flue for waste heat passing from furnace to chimney. The sides of the flue are corrugated so as to cause the flame to impinge on the vertical tubes, allowing a passage through the flue for cleaning. Some native oxide of iron from the Wharton mines in North Lancashire; specimens of ores and malleable iron from the West Cumberland Hematite Company; and specimens of ironstone from the Almond Iron Works, Falkirk, and other productions of the same kind, were minutely examined by most of the visitors. The Almond Iron Works are about 5 miles from the Carron Works, that were famous for big gun making before Sir Wm. Armstrong startled the world with rifled ordnance. A useful model was shown by Mr. J. Bell, being one of the Cleveland iron districts in this scale—horizontal, 6 in. to a mile; vertical, 200 feet to an inch. A model of a new method of transport was shown. The method has been tested successfully in Leicestershire, where it has been used for conveying stone from Messrs. Ellis and Everard's granite quarry to the railway, a distance of 3 miles. The plan has been worked out by Mr. Hodgson, C.E., and consists in the employment of an endless wire-rope, supported on pulleys, which are carried at a considerable height from the ground on stout posts, the entire arrangements having much the appearance of an ordinary telegraph line. A portable steam-engine drives the rope at about 5 miles an hour, and it carries with it a continuous stream of boxes, each holding 1 cwt. of stone. The rope is endless, so that the full boxes travel on one side of the supports, and the empties return on the other; the pendants by which the boxes are hung are especially formed to allow of their passing the points of support, which they do with perfect ease. This line crosses the country boldly, as an ordinary telegraph would. The system can be applied at a remarkably small cost. The descriptions we have given apply only to the more prominent and interesting articles that were exhibited, and do not by any means exhaust the display, which filled a building almost as large as the Victoria Hall at Leeds.

The first business meeting of the members was commenced in the Odd Fellows' Hall, Middlesborough, on Wednesday morning. His Grace the Duke of Devonshire, as already stated, undertook the duties devolving upon him as President of the Institute, and was supported on the platform by Mr. H. F. Bolckow, of Marton Hall, M.P. for the borough of Middlesborough; Sir William Armstrong, C.B., Newcastle; Mr. I. L. Bell, Washington Hall; Mr. Edw. Williams, Middlesborough; Mr. J. T. Smith, Barrow-in-Furness; Mr. R. Fothergill, M.P., Aberdare Iron Works; and several other vice-presidents. Amongst the unusually large company who were honoured with invitations, and nearly all of whom attended, were Lord Frederick Cavendish, M.P.; Mr. A. Brogden, M.P., Ulverstone; Mr. Jos. Doods, M.P., Stockton; Mr. Rupert Kettle; Mr. John Lancaster, M.P., Wigan; Messrs. William Adams, Cardiff; George Addenbrooke, Darlaston; John Addenbrooke, Darlaston; John Addle, Glasgow; William George Ainslie, Leadenhall-street, London; Henry Aitken, Falkirk; J. G. N. Alleyne, Alfreton; Charles K. Anderson, London; W. R. Anstice, Madeley Wood, Salop; Charles Attwood, Wolsingham, Durham; J. J. Bagshawe, Sheffield; Thomas Bantock, Wolverhampton; William Barrows, Tipton; Charles Bagnall, near Whitby; George J. Barker, Wolverhampton; Thomas Barker, Sheffield; William Barrett, Stockton; Charles C. E. Bartholomew, Broxholme, Doncaster; Alfred Baldwin, Bewdley; George Bedson, Manchester; Peter Duckworth Bennett, West Bromwich; Thomas Bell, Walker; T. Hugh Bell, Middlesborough; John T. Bell, Monkwearmouth; Henry Bessemer, London; Henry Bleckley, Warrington; Septimus Bourne, Workington; W. R. Bromage, Kidderminster; Jas. Brogden, Bridgend, Glamorganshire; J. P. Budd, Ystalyfera, Swansea; J. O. Butler, Leeds; Robert Cassells, Glasgow; Henry Cochrane, Middlesborough; W. T. Crawshay, Cyfarthfa Castle, Merthyr Tydvil; George Crompton, Nottingham; Wm. Crossley, Middlesborough; Wm. Curry, Westminster; David Dale, Sheldon Works, Darlington; William Davis, Aberdare; — Deakin, West Bromwich; Thomas Drane, Workington; Colin Dunlop, Glasgow; William Farnworth, Dudley; H. O. Firmstone, Stourbridge; Mark Firth, Sheffield; W. Fletcher, Workington; W. O. Foster, Stourbridge; Wm. Fowler, Chesterfield; Theodore Fry, Darlington; Edward Gilkes, Teeside Iron Works; John Gjers, Middlesborough; Henry Grazebrooke, jun., Stourbridge; Michael Grazebrooke, Dudley; William Griffiths, Treforest, Pontypridd; Edwin Grove, London; John Hartley, Wolverhampton; Robert Hannay, jun., Glasgow; Robert Heath, Stoke-on-Trent; John Heaton, Langley Mill, Derbyshire; Wm. Heath, Biddulph Iron Works, Stoke-on-Trent; Alfred Hewlett, Wigan; Alfred C. Hill, Middlesborough; J. C. Hill, Newport; W. R. I. Hopkins, Middlesborough; James I. Hopkins, Middlesborough; Thomas E. Horton, Shiffnal; James Holcroft, Tipton; James Hunter, Motherwell, N.B.; Edward Hutchinson, Darlington; Augustus H. Hunt, Birtley, Chester-le-Street; J. C. Ianson, Darlington; G. W. Jaffrey, Hartlepool; John James, Newport; Thomas Jackson, Coatbridge; J. J. Jenkins, Swansea; E. Jeffries, Bradford; C. G. Johnson, Stockton; J. A. Jones, Middlesborough; Alfred Jones, Bilston; Edwin F. Jones, Middlesborough; David Joseph, Cardiff; F. W. Kitson, Monk Bridge Iron Works, Leeds; Richard Laybourne, Tredegar; H. W. Lewis, Glamorganshire; Robert Lloyd, Middlesborough; Sampson Lloyd, Wednesbury; Francis H. Lloyd, Wednesbury; Sam. Lloyd, Wednesbury; Robert Longsdon, London; Walter Macfarlane, Glasgow; John McLean, M.P. Westminster; L. T. McEwen, Glaisdale Iron Works; T. Massicks, Milltom Iron Works, Cumberland; C. Markam, Staveley, Chesterfield; H. J. Marten, Wolverhampton; H. N. Maynard, Newport; William Menelaus, Merthyr Tydvil; Ed. Moreton, Barrow-in-Furness; William Murdock, Barrow-in-Furness; Walter Neilson, Glasgow; W. H. Nevill, Llanelly; W. G. Norris, Coalbrookdale; Thos. Page, West Bromwich; John Paterson, Harrington Iron Works, Cumberland; John Paton, Newport; John Parry, Ebbw Vale; J. B. Pease, Middlesborough; Walter Pease, Darlington; John Pearce, Newport; T. Perry, Bilston; Joseph Piper, Kidderminster; T. W. Plum, Shropshire; Jonathan Priestman, Consett; L. Hopkin Pritchard, Tybach, South Wales; James Radcliffe, Consett Iron Works; John Ramsbottom, Crewe; James Ramsden, Barrow; W. G. Ramsden, Liverpool; J. Reid, Tredegar; J. C. Ridley, Jarrow; L. Richards, Dowlais; J. J. Richards, Merthyr Tydvil; E. W. Richards, Newport; Edwin Richards, Tredegar Iron Works; E. M. Richards, M.P., Brooklands, Swansea; Thomas Richardson, Hartlepool; Richard S. Roper, Newport; W. S. Roden, M.P., Stoke-on-Trent; Joseph Robinson, Ebbw Vale Iron Company, London; Walter Robinson, Tipton; John Saunders, Kidderminster; H. W. Schneider, Barrow-in-Furness; C. W. Siemens, Westminster; Henry Sharp, Bolton; Josiah T. Smith, Barrow-in-Furness; Jas. Smith, Workington; Fred. Smith, Dudley; E. Fisher Smith, Dudley; G. J. Snelus, Merthyr Tydvil; N. Neal Solly, Willenhall; W. M. Sparrow, Wolverhampton; John Spencer, Coatbridge; Thomas Spencer, Kidsgrove; John Stevenson, Middlesborough; William Price Struvé, Cwn Avon, Taibach, Glamorgan; John George Swan, Middlesborough; J. E. Swindell, Stourbridge; J. J. Thomas, Newcastle; George Thomson, West Bromwich; J. M. Thomson, Calder Iron Works, N.B.; Thomas Udall, Silverside Iron Works, North Staffordshire; Thomas Vaughan, Middlesborough; Joseph Vaughan, Bishop Auckland; Edward Vickers, Brighton; T. E. Vickers, Sheffield; J. M. Voss, Landore, Swansea; John Westray, Barrow; — Whitelaw, Coatbridge; William Whitwell, Stockton; Thos. Whitwell, Stockton; Joseph Whitworth, Manchester; R. Wigram, Leeds; E. Williams, Middlesborough; Walter Williams, Tipton; J. W. Williams, Tipton; Joshua Williams, Aberdulais, Neath; Isaac Wilson, Middlesborough; John Wilson, Middlesborough; George Wilson, Sheffield; Alexander Wilson, Sheffield; Townsend Wood, Swansea; Solomon Woodall, Dudley; W. C. Woodcock, West Bromwich; H. Leebohrn, Sheffield; I. J. Harding, Major Staplyton, T. Knott, James Taylor, W. Cockburn, W. H. Jackson, William Gill, C. Hill, C. Ianson, A. Farmer, T. Brentnall, J. A. Manners, W. Petchell, John Anderson, E. Schmitz, C. E. Muller, J. P. Horning, A. Kauffmann, G. C. Whitwell, J. O. Purves, J. Ingham, James Mackean, F. Williams, C. J. Adams, William Smith, W. Watson, W. Barningham, W. Prossa, J. A. Thislethwaite, J. F. Laidler, E. Watteen, D. Joy, G. Cochrane, H. A. Swan, W. H. Brand, J. W. Mowbray, J. Morris, G. Dyson, E. Firmin, R. Stephenson, A Hallam, W. H. England, E. Natteau, C. J. Johnson, W. Shaw, jun., Mr. Whipham, H. F. Pease, A. L. Rake, Charles Pease, Mr. Hoffman, Henry Gearth, Mr. Grieveson, E. Y. Veitch, Isaac Bigland, G. C. Fryer, J. Ross, Mr. McLeod, A. C. Downey, W. Warner, Rev. J. McNiel, Mr. Rushford, J. Wivell, Keswick, &c.

The PRESIDENT, in opening the proceedings, said he had already had the pleasure on a former occasion of addressing the members of the Institute in reference to the position and manufacture of iron and steel, and as he had explained at some length the objects of the Institute, and the purposes for which it had been established, he did not propose to open the meeting with more than a few preliminary remarks. He congratulated the members on the interest manifested throughout the country in the objects of the Institute, which seemed was apparent from the number of gentlemen who had already become members. His Grace referred to the appropriateness of selecting Middlesborough as the place of meeting, the town being the centre of so large and important a district, and the cradle and the birthplace of the Institute. He, however, recommended the holding of successive meetings at different parts of the country, as being more likely to establish a friendly intercourse amongst the members, and would enable the general body of the members to acquaint themselves with the various processes, and modifications of processes, as they might be carried out in different parts of the country. (Applause.)

Mr. JONES (the secretary) read a list of 72 names of gentlemen seeking election as members of the Institute. They were all elected.

DEVELOPMENT OF HEAT IN BLAST FURNACES.

Mr. ISAAC LOWTHIAN BELL read the first paper, which was on the "Development of Heat, and its Appropriation in Furnaces of Different Dimensions." Mr. Bell said the paper derived its interest from the fact that the ironmasters of the Cleveland district had in recent times greatly reduced the consumption of coke, by a series of successive increases given to the capacity of furnaces. Each enlargement has been followed by some saving, and a question of great importance to the trade is the extent to which this increase to the size of their now colossal furnaces can be made, with any hope of a saving to come pensate for the large additional outlay. It was to solve this enquiry that the writer had devoted some care in reviewing all that he knew had been accomplished by large furnaces of different dimensions, and supplementing this information by extensive experimental research. Mr. Bell gave a short explanation of the phenomena attending the combustion of carbon, and the modes of measuring its effects. He then pointed out how the effects of such combustion was modified, according to the extent to which the carbon united with the oxygen. In a furnace he showed one or two combustions to be possible—that of one equivalent of carbon uniting with one or with two of oxygen—stating at the same time that in the latter instance as much heat was developed by 20 cwts. as was done by 71·14 cwts. when the carbon only united with one equivalent of oxygen.

He next pointed out the nature of the cause which resulted in a saving of 6·60 cwts. of coke per ton of iron when a furnace of the original type, and containing 6000 cubic feet, had its capacity doubled, or thereabouts. This was stated to be due to two causes—first, the intercession of a considerable portion of the heat formerly carried away in the gases and the products of combustion of the old furnaces. The saving from this cause amounted to 3·03 per ton of iron. The remainder was due to a better state of oxidation, or combustion of the carbon—a state of things proved by a great number of chemical analyses of the gases themselves as they leave the furnaces. Mr. Bell then showed that no subsequent addition to the size of the furnace had been attended with anything like the saving which had accompanied the first one, and this was due to the fact that the escaping gases had, by such increase in dimensions, been deprived of nearly all the heat they could be made to surrender for use in the furnace, and that the chemical action in the furnace of about 12,000 ft. was as perfect, so far as numerous analyses of the gases could indicate, as it was in a furnace of 25,000 cubic feet. From the results obtained from furnaces of different capacities, it was considered that the amount of heat actually appropriated to the work of furnace was expressed by about 67,000 cwts. units, to which had to be added that absorbed by escaping gases, varying from 10,800 in the larger to 19,113 in the smaller furnaces. Mr. Bell compared this with the number deduced from considerations of a purely theoretical nature, based partly on the experiments of chemists and partly on his own researches. The sum of this estimate is as follows:—

	Heat units.		Cwts.
For reduction of peroxide of iron in the ore ..	30,058	= coke	8·01
For fusion of 20 cwts. of iron	6,600	,,	1·78
For fusion of 29½ cwts. slag	16,225	,,	4·31
Decomposition of water in blast	2,788	,,	1·03
Expulsion of carbonic acid in limestone.....	2,220	,,	·81
Conveyed away by heat communicated to tuyere water	1,816	,,	·56
Radiation, conduction, and conversion from outside of furnace.....	3,343	,,	·88
Total	63,050	,,	17·38
Loss by gases	10,800	,,	2·88
	73,850		20·26
To which add the carbon to combine with the iron—·74 cwts. coke			·80
Total			21·06

Thus, the theoretical units are strikingly near the number obtained in actual practice. Allusion was next made to a superiority in the working of the furnace of the largest class—25,000 feet and upwards—when richer iron appeared to be produced with a smaller expenditure of heat than is required in furnaces (say) of 11,600 or 12,000 cubic feet. This anomaly the writer considers may be due to a chemical re-action between the elements of carbonic oxide—the reducing agent in all blast-furnaces. This change, which he observed took place at a very low temperature, he thought the probable source of carbon in pig-iron. In his analysis of the sources of heat in the process of smelting the iron he pointed out exactly what is due to the direct combustion of the fuel, and that due to the heat conferred on the blast. He holds the primary advantage derived from using hot air to be due to the circumstance that, inasmuch as a combustible burnt in the heaters gives out nearly its full equivalent of heat, that consumed in the blast-furnaces, by being only partially oxidised, scarcely gives out the half. Besides this, the blast in the Cleveland district being exclusively heated by the waste gases, affords a stronger reason why of the quantity of heat required for the operation as many units as possible should be got from the blast, in order to economise those obtained from the coke. The want of durableness in the iron pipes in which this preliminary heating of the blast is secured, however, imposes a limit to its being raised in temperature much above 1000 Fahr. Reference was made in the paper to the progress Messrs. Cochrane and Co. had effected in the adaptation of Mr. Siemens's regenerative system, in which the air is heated by sweeping over surfaces of firebricks, previously heated. Mr. Bell believed that so long as the fuel itself used in the blast-furnace is oxidised as it now is—one-fourth to the condition of carbonic acid, and three-fourths to carbonic oxide—the great benefit anticipated by some from air heated very high cannot be realised. Thus, if 67·000 cwts. units of heat are required for 1 ton of iron, exclusive of waste by gases, it is obvious, if coke has to provide a smaller share than it does at present, the number of units thus deficient must be supplied by the heat of the blast. But reducing the quantity of coke means, also, a corresponding reduction of air driven into the furnace; so that, at the same time, if the blast is called upon to convey a larger number of units into the furnace this duty has to be performed by a greatly reduced quantity of air.

From the figures given in the paper, it would appear that a furnace using 13 cwts. of coke, would require its blast heated to 3632° Fahr., or to cover the loss from escaping gases, to above 4000°, a temperature above the heat of the interior of the blast-furnace itself, and far beyond the power of any stove and its attendant apparatus to withstand.

Mr. R. FOTHERGILL, M.P., Aberdare, opened the discussion which ensued upon the reading of the paper. He observed that after listening to the remarkably valuable paper, which contained so much that was interesting and useful, he should like to ask Mr. Bell precisely what he meant by speaking of enlarging the capacity of the furnaces from 6000 to 25,000 feet, or upwards. Did he mean that the height of the furnace was raised, or the cubical contents increased, or both?

Mr. BELL explained that in speaking of 6000 and 25,000 he, of course, meant cubical contents. They were increased and enlarged proportionately to the increased height.

Mr. FOTHERGILL next asked if the quantity of blast introduced into the small furnaces was identical with that introduced into the larger ones?

Mr. C. W. SIEMENS, Westminster, said he had listened with great interest to the paper, which dealt with the question of blasting practically, and as an economical question. He thought in all operations they should endeavour to look at the ultimate results they could possibly obtain, and then try in practice to approach those results by the best means they could think of. (Hear, hear.) The question of the chemical economy of blast-furnaces was discussed at Birmingham some time ago, and in arguing the subject he disagreed with some of the speakers as to the great results that might be expected from the mere increase of capacity or height of the furnace. He could not see that that capacity, when it had attained to a certain limit, could be beneficial as a mere absorber of heat in order to increase materially the economy of the furnace. He was glad to see from Mr. Bell's elaborate investigation of the subject that that view came out something correct. Mr. Bell gave the result of his investigation based upon theoretical and partly upon practical grounds; and although the two investigations were totally distinct, and although they each viewed the question from a different point, the result agreed almost within a fraction. He thought he came to the conclusion that the minimum quantity in blasting Cleveland ore would be 21 cwts., and Mr. Bell's calculation came to within 1 cwt. of that figure. That coincidence of results was the best proof that could be brought forward of the correctness of that view of the case. And at that meeting they had had the whole question much more thoroughly brought before them, and he thought the paper which they had just heard read would remain a standard paper on the subject. (Loud applause.) Mr. Bell had made very valuable suggestions with regard to the carbonisation of iron in blast-furnaces. He had discovered that iron ore absorbed carbon from carbonic oxide, and that the degree or amount of absorption probably ruled the quantity of pig metal produced. That was a new view of the case, and he had great belief in it. It would serve to explain many apparent anomalies. The next question that Mr. Bell touched upon regarded the hot-blast, and on that he was not quite so well prepared to agree with him. No doubt he had viewed the question very maturely, and he, therefore, hesitated to dispute the results; but still, on viewing the question from another point of view, he would come to a conclusion different from that of Mr. Bell. Probably, on comparing the two ways, a result might be arrived at that would in some degree modify the figures placed before them. Mr. Bell showed that by increasing the blast beyond the ordinary limits of 600° it would increase the economy in but a very slight degree. His own view was that it would affect it very nearly in the same degree as an increase of (say) from 60° to 600° would affect it. He was of opinion that an increase of the temperature of the blast must be highly economical in the results.

Mr. CHARLES COCHRANE referred to his observations addressed to the Mechanical Engineers at Newcastle, and quoted the basis on which he had stated that 13 cwts. was the ultimate consumption of coke per ton of iron, if a proper temperature of blast could be obtained. For every 100° Fahrenheit that the temperature had been raised they found a saving of 1·34 cwt. of coke per ton of iron. Until it was shown that, as they got higher and higher in temperature the saving became less and less, it would be fair to infer that as the temperature increased, so the saving of coke would be increased *pro rata* each 100°. If the saving could be maintained beyond 1300°, at which they made 1 ton of iron with 21 cwts. of coke, and could reach 2000°, he thought he would be within the mark when he held that it could be accomplished with 13 cwts.

Sir WILLIAM ARMSTRONG next rose to speak on the question, and was received with applause. He said he was afraid the subject that had been so admirably treated by Mr. Bell was one upon which he had scarcely any practical experience, and, therefore, he would not be expected to communicate anything of value upon the subject. All the knowledge he had upon it was of a theoretical character, and of a very general nature. He might observe, however, that the subject had been brought very prominently before the Royal Coal Commission, of which he was a member, and they naturally attached very great importance to it, because there was no one branch of manufacture that consumed fuel to a degree comparable with that of the manufacture of iron. Therefore, in a national point of view, it was of the utmost importance that the economy of fuel should be carried to the greatest possible point in the trade of manufacture. Mr. Bell gave them some very valuable evidence before the committee upon the same subject, and his friend and partner, Captain Noble, upon whose practical experience and scientific knowledge he had the greatest possible dependence, had, at his instigation, made a very careful investigation into the same subject in connection with their two furnaces at Elswick. The results he arrived at, he might observe, coincided very closely indeed with those which Mr. Bell had brought forward. (Applause.) The impression on his mind certainly was that no considerable saving was to be effected by a further augmentation in the capacity of furnaces. (Applause.) He should be very glad if Mr. Bell, when he answered the various questions that had been put to him, would make it a little more clear what was the separate influence of additional height, as distinct from the capacity of furnaces. (Hear, hear.) The main question which

had been before them of late years was, what advantage was to be obtained by further increase of height; and he should like to know whether that resolved itself simply into a question of capacity, and whether it was necessary to draw any distinction between capacity in volume and capacity in point of height?

Mr. COWPER observed that the 1 cwt. saving of coke per 100° had not only held good at the moderate increase from 650° to 1150°, but there was 1·3 or 5 cwts. saving from 921° to 1383°, on an average over a length of time. Therefore the 1 cwt. saving per 100° would hold good, he thought, up to even 1400° or 1500°.

Mr. COCHRANE would give more detail of the results he had obtained if it were desired. He could give the results for July, during which month the working heat varied from 1118°, the minimum, up to 1400° and upwards, the average during the month being 1279°, against 851° in the old furnace—a difference between the two of 418°. The yield of that furnace at which the cooler blast was employed was 26·02; while the yield of that at which the higher heat was employed was 20·79—a difference of 5·23 cwts. There was a slight difference to be made for quality of iron, which would bring out the difference at 5·60 cwts. for 418° temperature; that would run about 1·34 cwts. per 100°.

Mr. W. S. RODEN, M.P., Stoke-upon-Trent, contended that each increase in the size of the furnace had been of advantage, and had diminished the quantity of fuel. He presumed that Mr. Bell's experience was based upon the use of the purest and best description of coke, and that coal was not used. In the West of England a large quantity of coal was used, and he did not altogether agree that the increase of size of the furnaces led to a diminution in the quantity of coal used. Here the minimum quantity was said to be 20 cwts. of coke per ton; that in large furnaces represented 36 or 38 cwts. of coal. There was a considerable difference between the use of coal and coke in blast-furnaces. He must agree with Mr. Siemens that they had not yet reached that point when they could say that blast-furnaces should not be increased any more. From his experience he thought that they had not reached anything like the dimensions which could be successfully adopted?

Mr. THOMAS WHITWELL had not understood clearly whether Mr. Bell's deductions were made from experience with regard to Cleveland ironstone solely. The practice on the Continent, he had lately found, especially in Luxembourg, to be—with stone of only 35 per cent. yield, with furnaces 50 ft. high and 15 ft. bosh, and with blast—no hotter than once was used here, about lead-melting heat; that the stone was smelted with from 20 cwts. to 21 cwts. of coke; and that coke, moreover, never made more ash than our own, varying from 11 to 13 per cent.

Mr. JOHN PATTISON asked as to the manner in which the analysis of the gases was conducted?

Mr. WILLIAMS, as a practical ironmaster, thought they were very much indebted to Mr. Bell for the paper he had read, and for the very valuable investigations he had made, not only now, but heretofore, in connection with blast-furnaces. They had all acquired, and principally from Mr. Bell, such a knowledge of what was going on in connection with blast-furnaces and the making of pig-iron as few practical men were before possessed of. He did not, however, think the present paper had put the thing as clearly as Mr. Bell usually did in explaining how economy in fuel was brought about. He himself had often attributed that increased economy to increased capacity; and he also thought that they would not have had increased economy if the furnaces had been retained at their original height—about 50 ft. Mr. Vaughan's theory was that it was in the excessive height over the other dimensions that they should find economy. They acted upon that principle; they built two furnaces 95 ft. high and 16 ft. in the bosh, and having, as far as he remembered, a capacity of 10,000 ft. A very considerable economy in fuel was the consequence. Since then it had become the practice in the district to build furnaces of a very much larger capacity than those, and, acting for the company whom he represented, he had followed in the wake of their neighbours, and now they had got a furnace of 22 ft. and two of 23 ft., with a capacity of 20,000 ft., alongside of the three furnaces of 16 ft. in the bosh, and of the capacity of some 9000 or 10,000 cubic feet. There was no economy of fuel due to greater capacity in the wider bosh furnaces; on the contrary, he was strongly of opinion that there was a perceptible economy in the narrow bosh furnaces over the wider bosh. (Applause.) It was not a very marked economy, and for that reason he could not speak very positively. But there was a wonderful regularity about the figures that went in weekly, monthly, three-monthly, and six-monthly, which seemed to show a shade of advantage in respect of the fuel consumed in the smaller furnaces, as compared with the larger. All were of the same height, and it was merely a question of width of bosh. As regarded the furnaces spoken of by Mr. Cochrane, it seemed to him to be very exceptional where a furnace having the blast heated to 850° should use 26 cwts. of coke. In his experience, they oscillated between 22 and 23 cwts., and they never had anything so high as 26 cwts. Even in the old furnaces, only 60 ft. high, and working at nothing like the heat, the consumption was considerably below 26 cwts. To use 26 cwts. of coke in a modern furnace, with a blast of 850°, was something very exceptional.

Mr. JOSIAH T. SMITH (Barrow-in-Furness) said that in his district they were using chiefly the same coke as the manufacturers in the North, and ores of a very soft character. They started with a furnace of something over 6000 ft., but seeing what was doing in the North they some four or five years ago built five others, with a capacity each of nearly 12,000 ft.; but the result of the working of the larger furnaces was that they were not worked so economically as the smaller. The consequence was that as soon as they could get the large furnaces out of blast they reduced them from 22 ft. to 17 and 17½ ft. boshes; and since that had been done a large economy in coke had been observed. Whether that result was due to the reducing of the width of the boshes, or the capacity of the furnace, he was not prepared to say. His notion was that it was due in part to both causes. They had continued to make experiments as to the proper diameter of the boshes, and he was bound to say that they were gradually coming down to 16 ft. 6 in. and 17 ft.

Mr. NEAL SOLLY (Willenhall), speaking as a practical ironworker of South Staffordshire, said that with their material they found that a smaller bosh worked to a much greater advantage in the yield than large ones. They had worked with 16 ft., 15 ft., and 13 ft. 6 in. boshes, and found the yield of fuel had been better than with larger ones. With the best South Staffordshire ironstone they had found the yield better than with other descriptions, but the best yield had been 1 ton 12 cwts. of coal to 1 ton of iron, which weight would, of course, be much less if reduced to coke.

Mr. BELL replied upon the whole discussion. He pointed out the practical difficulties which attended the question of capacity of the furnace—on the one hand, if the furnace were of such a height, the mechanical difficulty of forcing the blast through a furnace of that extent; and on the other, if it were increased in diameter, the difficulty of spreading the material over the large space. He did not see how Mr. Williams had arrived at his conclusions, for so far as ordinary observation enabled them to determine he did not see how any such conclusion could be drawn. After Mr. Bell had concluded his reply, which in parts assumed a purely technical character,

Mr. R. A. BROGDEN, M.P., suggested that it would be well to resume the discussion on the following day.

Mr. BELL thought it would be well if some member prepared a paper in answer to his assertions.

A hearty vote of thanks was then accorded to Mr. Bell, on the proposition of the noble CHAIRMAN, for his extremely valuable paper.

SIEMENS'S REGENERATIVE FURNACE.

Mr. JOSIAH T. SMITH, Barrow-in-Furness, next read a paper "On Siemens's Regenerative Gas Furnace, and its Application to Re-heating Furnaces connected with Rolling Mills." Although, the writer said, this subject had been brought before various societies since 1862 by some of the most eminent men of the day, and for many years had been in extensive and successful operation in various processes connected with manufactures, both at home and abroad, it had, with very few exceptions, not been adopted in the iron and steel works of Great Britain. It was possible, however, that in a few years those districts which contained large quantities of inferior coal or fine slack, without sufficient bituminous principle to make it available for coking purposes, would find that they possessed by means of the above invention the opportunity of supplying their requirements from such sources. While in this country it was probable that coal would exclusively be used to produce the gaseous fuel required for the regenerative furnace, in France, Belgium, and Spain they merely used wood; in Germany lignite, and peat in Italy. It was believed that the first idea of storing waste heat to be used at intervals was due to Dr. Stirling, of Dundee, who, in 1817, patented the Regenerator or Heat Accumulator, and subsequently applied it to his caloric engine. Capt. Ericsson, in 1851, also used a kind of regenerator to his air engine; but Siemens had, in the years 1847-8-9, taken out patents for his Regenerative Steam Engine and Condenser. None of these inventions ever came into extensive practice, and not till 1862 did the discovery really assume a shape which was at all attractive. The invention might be generally described as requiring a producer—for the volatilisation of coal, wood, peat, and such like products into gases—which might be erected at any practicable distance from the furnaces to which they were to be applied; while a regenerator, divided into four compartments filled with loose fire-bricks, had to be placed under the furnaces. These regenerators were simply fire-brick chambers divided into four compartments, one on each side for the passage of gas, and two in the centre for air, with generally five ports at each end communicating with the furnaces above. The chambers were filled with fire-bricks placed in a chequered manner, and while the upper portion had to be of the best quality, those beneath would answer if they were of the most inferior description. The chemical action which took place in the producers was described by Mr. Siemens in his lecture before the Chemical Society as follows:—"Air is admitted at the grate, and, as it rises slowly through the ignited mass, the carbonic acid first formed by the combination of the oxygen with the carbon of the fuel takes up an additional equivalent of carbon, forming carbonic oxide, which, diluted by the inert nitrogen of the air, and by a little unreduced carbonic acid, and mixed with the gases and vapours distilled from the raw fuel during its gradual descent towards the grate, is led off by the gas tubes to the furnaces." The temperature of the gas at the junction of the upcasts with the tubes was from 1250 to 1300° Fah., a higher point than yet noticed. Before it had travelled 200 ft. in the tube, with external atmosphere of 60°, the temperature was reduced to about 130°. He had himself been unable to ascertain the exact quantity of heat lost by radiation in the interval, but the experiments, although not complete, were sufficient to show that the quantity was so small that at present he could see no way of economically applying it. This lowering of the temperature and condensation of the gases was of advantage in many respects. The gas being heavier caused, in its transit through the tubes and the various downcasts, a syphon action, and thus not only drew the gas from the producers to the furnaces, but by keeping up a slight outward pressure prevented the admission of air through any crevice in the tubes or the expansion boxes. It also deposited the tar from the coals into a series of wells beneath; while the water in the fuel was also condensed, and thus prevented from causing a great waste of metal, by introducing a too great supply of oxygen into the furnaces. After noticing more in detail the application and effect of the gases, Mr. Smith added that for many months each producer at Barrow had volatilised 3 tons of coal per 24 hours, and that the greatest economy effected was when the consumption had now exceeded 50 cwts. Estimating the weight of one cubic foot of gas at the ordinary temperature of thin air to be ·075 lbs., the volume of carbonic oxide, hydro-carbon, and hydrogen from 1 ton of coal would be about 53,000 ft., and the volume of nitrogen about 122,000 ft., making together a total of 175,000 ft. The consumption of coal in the producers at Barrow being 500 tons per week, it gave an amount of gas, passing through the tubes at the rate of 6½ ft. per second, of 87,000,000 cubic feet; or through the various furnaces, adding the quantity of air there admitted, of 6600 tons. The saving of fuel by this process at Barrow was, over a period of two years, no less than 44 per cent.; but the actual money saving, by the use of a particular kind of coal, had been more than one-half. The yield of the gas-furnaces, taken over the same period, showed a saving of 31 per cent. as compared with the work at the firing-furnaces, and the amount of repairs was just two-thirds of the old cost. In these three particulars was undoubtedly to be found the chief economy; but the adoption of the system enabled them to preserve greater cleanliness and order in their works, and an entire absence of smoke met a difficulty which, in the neighbourhood of large towns, was every year becoming a greater grievance. There was, he admitted a slightly increased outlay on the plant; but, taking into consideration the increased capabilities as to quantity, it would be found to represent the difference in cost between the two systems.—The paper, which was illustrated by many complicated diagrams and models, subsequently led to a slight discussion, after which a vote of thanks was passed unanimously to Mr. Smith, and the business part of the day's proceedings terminated.

NEW PROCESS OF REFINING IRON.

The members dispersed for luncheon about half-past one o'clock, and were afterwards afforded opportunities for inspecting the many places of attraction about the neighbourhood. The most interest, however, was manifested in Mr. Palmer Budd's new process of refining iron, which was shown during the afternoon in the magnificent works of Messrs. Bolckow and Vaughan. It appears that a patent has been taken out by Mr. Budd for the invention of such "improvements in the manufacture of iron and steel" as shall henceforth render the process of puddling much quicker and easier. This valuable result is said to be accomplished by the subjecting of molten cast-iron to the action of soda and soft hematite iron ore—or other oxide of iron—previous to its being subjected to the puddling process. For this purpose the molten cast-iron is run into shallow pans capable of containing it at a depth of from 3 to 5 inches, and lined with a paste composed of a mixture of the materials above mentioned, or of either of them separately. When the fluid metal is poured into the pans a violent ebullition takes place, and a large proportion of the silica—together with some of the carbon, phosphorus, and sulphur contained in the iron—is carried off in the slag, so that when the slabs of purified metal are subsequently worked in the puddling-furnace, the operations are effected much more rapidly than with ordinary pig-iron. This is accounted for by the fact that when puddling the ordinary pig only a very small proportion of carbon is separated from the iron before the great bulk of the silica is eliminated. Cast-iron, if of a suitable quality for steel-making, may also advantageously be acted on by a paste containing nitrate of soda or hemate ore, or both combined, in shallow pans, as above described, previous to being decarbonised for conversion into steel. The experiments of yesterday were carried out under the personal supervision of Mr. Budd, and seemed to give general satisfaction to the large party by whom they were witnessed. Two properly prepared moulds were at the outset formed at the foot of No. 2 blast-furnace, and having then poured into them a bucket full of the refining mixture already alluded to, the speedy evaporation of the water lift a thin layer of paste adhering to the bottom and sides. The molten iron was then released from the furnace and allowed to run gradually down to the moulds; but no sooner did the liquid come in contact with the patent mixture than thousands of fiery particles were shot high into the air, and "fumes" in large quantities were evolved, as if to afford a proof that the refining had commenced. Almost at the same moment countless jets of flame burst from the surface of the metal, and burnt for a considerable time; while a quantity of scoriæ, which can be separated from the plate of iron when cold, was also thrown violently to the surface. About 30 lbs. or 40 lbs. of this scoriæ was afterwards removed from each 13 cwts. slab of metal, and the product was then ready for the puddling process as an advanced refined material. It was alleged by the patentee that the puddlers much prefer the iron in this condition, as it lessens and helps their work; and also that it will tend materially to cheapen the process of manufacture The visitors were afterwards kindly shown the resources of the fine establishment, and having the benefit of Mr. Williams's great experience in describing the most characteristic features of each department, the inspection passed off very pleasantly and agreeably to all concerned.

[*To be continued in next week's Mining Journal.*]

Original Correspondence.

COLLIERY WORKINGS—FOWLER'S CLIP-DRUM.

SIR,—In reply to the enquiry of "J. B.," respecting Fowler's clip-drum, I think that in the case he describes it would answer most admirably. The clip should, I think, in that case be placed horizontally, and the gradient will have to be taken into account when fixing the diameter of the drum, and also the size of the rope. He is quite right in supposing that a great saving will be effected in ropes, &c., by putting the clip-drum in, instead of an ordinary drum. If the full wagon goes down the plane against the empty one, it will probably be necessary to attach a brake to the drum; but if the reverse is the case—that is, if the empty wagon is to go down against the full one—the brake will be unnecessary. The clip-drum is made by Messrs. Fowler, engineers, Leeds.—*Newcastle, Sept.* 20. M. E.

P.S.—I have omitted to state that, in addition to the saving in erections, there is a great saving in steam-power, as the weight of the wagon descending materially assists the engine, and the full benefit of this power—that is, the power got by a wagon descending a plane—is got by using a clip-drum.

COLLIERY WORKINGS.

FOWLER'S CLIP DRUM AND PULLEY.

SIR,—Will "M. E.," or any of your readers, or Mr. Fowler or his agents, inform me where I can see a clip drum pulley pumping water, under the following conditions, viz.:—Length of plane, 1200 yards, dipping 1 in 12, making the vertical column 100 yards? I want to pump this water in one column, or lift, for which purpose I am laying 4-in. pipes. I propose using a 4-in. double-acting pump, with 12-in. or 18-in. stroke.—*Sept.* 22. ENQUIRER.

COAL-CUTTING MACHINERY.

SIR,—I think all those asquainted with the getting of coal must form a similar opinion of Mr. Walker's machine to that of "A Miner." If they will examine the specification of Messrs. Cooke and Hunter, dated 1866, No. 433, they will find a description of an undercutting machine, driven by internal teeth, so arranged that they cannot be seen without taking the machine to pieces, and they are, therefore, not at all exposed to dust. This machine can cut more than half its diameter. A cutter (say) of 5 ft. can be made to cut about 3 ft. 2 in., and it is so mounted that it can bed itself into the coal or other substance without having a free end to begin upon; and when the machine is not at work, or has to be run along to a fresh place the cutter-ring can be immediately turned round, so that its centre will be in the centre of the carriage, right betwixt the rails. There is sufficient strength in this machine to enable it with the same tools to do the same forward rate of cutting. As yet it has only been used for slate, and of a smaller size, to cut 2 ft. 4 in.; this it does at a speed of 2 ft. 6 in. per hour, requiring about 1-horse power. This may appear to some slow work, but there is a great deal of difference betwixt slate and coal. I am afraid, however, that a machine which requires to be about 5 ft. diameter to undercut 3 ft. 2 in., though applicable to quarries, may be too cumbersome in a coal pit. G. HUNTER.

Aberdovey, Sept. 21.

COAL-CUTTING MACHINERY.

SIR,—Your reference to the improved coal-cutting machine invented by Mr. Walker has caused the question of substituting machine for manual labour in coal-cutting to be again discussed. There is no doubt as to the want of novelty in Mr. Walker's invention, but if the principle be right there is nothing to prevent its adoption. But I have no confidence whatever in the rotary cutter, and believe that if any coal-cutting machine be introduced it will be a pick machine, and for reasons which are not difficult to explain. As to the speed of cutting by machinery, I think it has been much exaggerated, and that taking a reasonable period, say a couple of months, the same number of men would do quite as much without the machine as with it; yet there may be some advantages in the machine, looking at it from the masters' point of view, because it can be worked with less skilled labour, and, therefore, if the same amount of coal can be cut the machine would do it the cheaper. But then there is the question whether the coal would be got in the same state, and thus machine-cut coal might leave the master less profit than that cut by manual labour, although the latter would cost him more per ton.

The several kinds of machines I have seen appear to be all referable to three classes. In the first place, there is the pick machines, which probably approach most nearly to manual labour, yet they do not hole so clean, because it is a dead blow, and not a pick-up blow, that the coal receives, consequently the coal is more damaged. Again, when a man is holing he gives a twist to his pick after the blow which moves the coal out of the way, so that it is not damaged by the next blow—this, of course, a machine cannot do, as every blow of a machine must be uniform. But a good pick machine does not do such very bad work whilst it is at work, the only thing is that it is so frequently out of order.

The second kind of machine that was introduced, and that was fully ten years ago, was the circular-saw principle, like Mr. Walker's, but although that does its work very well it occupies so much room that it is only in exceptional cases that it can be used, and, after all, it is an awkward and inconvenient machine, and costs a great deal to make. As to the third kind, it is the chisel machine, like that of Messrs. Carrett and Marshall, and if this could be worked with less power it would be a first-rate machine, but the power required is enormous. Whether it could be worked with steam I do not know, but if so, this might overcome the difficulty. I believe that by giving the cutters more of a plate form, not more than one inch of coal need be damaged, so that the coal could be got in the best possible form, and (the difficulty as to power being overcome) at a very small cost. The matter of coal-cutting by machinery is at present but little tried, and I think that at no distant time the obstacles which now prevent the general adoption of machine-cutting will be surmounted.—*Sept.* 22. COLLIER.

PREVENTION OF COLLIERY ACCIDENTS—ILLUMINATION OF MINES.

SIR,—As several of your correspondents seem to entertain the idea that the best means of preventing colliery explosions is to avoid altogether the bringing of flame in contact with the atmosphere of the mine, it appears strange to me that so little has been done to introduce electricity as an illuminating power for mines. I am fully aware that an electric light, such as most people recognise as an electric light, is not at all applicable to mines, and would be of no more practical value than the looking-glasses which some ingenious individual proposed in order to illume them with daylight, but I think a small portable light would not be objectionable. The electric lamp of Dumas and Benoit was an admirable contrivance, and it was probably its cost alone that prevented its coming into general use. The question, then, is can we have some such light as the Dumas and Benoit at a price which will permit of its adoption for mining purposes—and, if so, by what means that system of lighting mines can be secured?

The lamp to which I refer is essentially a Geisler's tube, and its great advantage in connection with lighting mines is that the slightest fracture breaks the circuit, and the light is gone. It is obvious that with such a lamp the extinguishing of the light is the greatest inconvenience that can possibly arise—to bring flame in contact with the external atmosphere is impossible. These tubes could be manufactured and sold, if required in anything like quantities, for three or four shillings each, so that the only remaining difficulty would be as to the electricity. I do not know whether it would be practicable to supply a series of lamps from one source, more especially as the breakage of one would, so far as I see, extinguish the whole, but even this is a difficulty which could probably be overcome; or, if each lamp must have a distinct supply, perhaps an electric machine could be made sufficiently cheap to permit of each set of miners having one for themselves. I fear voltaic electricity would not be available, as the wear and tear of the batteries would be so great that it would become a very costly kind of light; and there would be another objection—that the batteries would want continual attention, which the miners could not give them. Frictional electricity would also be inapplicable, because a machine of sufficient power to produce the required light would scarcely be portable, unless it were driven by a greater power than would be likely to be at the command of the person requiring the light. Dynamo-electricity would, therefore, appear to be the only kind available.

I recollect seeing a most ingenious and simple machine of this class, which would, doubtless, exactly answer the purpose—it was, I think, at one of the *soirees* of the Polytechnic Institution, in London, and was the invention of the principal assistant of Mr. Ladd, the well-known philosophical instrument maker. The machine consists of a pair of soft iron plates, wrapped in several layers of insulated wire. These plates are placed horizontally, one over the other, and have at each of their extremities a revolving armature, of the form proposed, in 1857, by Mr. Werner Siemens, of Berlin—they are cylinders of soft iron, deeply grooved in the direction of their length, and wound in the groove with insulated copper wire. The armatures revolve in hollow cylinders of equal length, and only sufficiently larger to permit them to turn freely. These hollow cylinders are formed of two thick bars of soft iron, separated by an equally thick plate, of brass, all firmly united, and then bored longitudinally. These cylinders are interposed between the extremities of the wrapped plates, serving to keep them apart, and the whole is then bolted together. Of course, there are the necessary arrangements for giving a common direction to the currents. By rotating the armature, electric currents will be excited in the enveloping wire. The currents thus developed pass the commutator into the wire that wraps the plates, and the rotation being in the proper direction will tend to reinforce their magnetism. The succession of mutual reactions goes on until the current, at first very feeble, becomes of great intensity. The second armature supplies the electricity for the lamp.

Now, although this description may appear rather complicated, the instrument itself is by no means so, and if it could be made and sold at about a dozen shillings, as I should think it could be, I am sure it would come into general use. Blasting with gunpowder need not then be prohibited—for if the powder were ignited with an electric fuse I am convinced that no danger whatever would result. The inebriety complained of by Mr. Higson could not with this arrangement endanger the lives of the colliers of his district, and I am sure that the electric safety-lamp would far surpass any referred to by "M. E.," in his letter published in the Supplement to the Journal of Sept. 4.—*Sept.* 20. SAFETY.

PROGRESS OF COAL MINING IN THE RHONDDA VALLEY, SOUTH WALES.

SIR,—My last letter gave some of the principal features connected with the working and sinking for steam coal in this valley. I now give some account of the collieries producing house coal, obtained principally from the No. 3 seam, in the lower portion of the valley. They commence near Newbridge, or Pontypridd, and extend upwards as far as Bwllfa level, comprising Bwllfa, Llwynpia, Dinas, Cymmer, Llwyn Celyn, Coedcae, Troedrhiw, and Great Western Collieries. No. 3 seam is got at Bwllfa level to the extent of 150 tons per day. Mr. Forthergill is the lessee of the royalty, and the coal is used at the Abernant Iron Works. At Llwynpia, No. 3 seam is extensively worked from the depth of 106 yards, the steam coals are also sunk to here, the 9-feet seam being about 400 yards deep, recently got. At Dinas, No. 3 seam is got by level; it was also—owing to a large fault—worked in Dinas upper pit, but is now exhausted in that quarter. The gas produced from the Abergorky seam is conveyed in pipes up to the top of the pit, and has burnt there for many years. No. 3 seam is worked at Cymmer to the extent of 300 tons per day from 100 yards depth. The winding-engine has two 25-in. horizontal cylinders, 4-ft. stroke, direct action, 10-ft. drum, round wire-ropes, slide-valves. A small engine pumps from the bottom of the pit, with two 9-in. sets—one lifting, one forcing. A trial pit is sunk to the Abergorky seam in the mine, from which gas is conveyed in pipes to the top of the pit, and is used there for lighting. There are 46 coke ovens at Cymmer, and 70 at Dinas, using the small of No. 3 seam. At Llwyn Celyn, No. 2 seam is worked, and raised by water-balance; the water is pumped up again by means of a water-wheel. At Coedcae Colliery the depth to No. 3 seam is 120 yards, about 350 tons per day got; the winding-engine has two 25-inch horizontal cylinders, 4-ft. stroke, direct action, 10-ft. rope-rolls, flat wire-rope, slide valves. A small engine, now pumping from the bottom of the pit, was formerly used for hauling underground in its present position; there are 67 coke ovens here. At Troedrhiw about 200 tons per day of No. 3 coal are raised by water-balance, no coke ovens. The dip of the coal seams in this section is generally south-east; it is not, however, uniform, and varies in one colliery. The springs of water are not large at any of these collieries, a small engine suffices for pumping purposes at each colliery. Fire-damp is not produced so freely as in the steam coal seams. The No. 3 seam is remarkably uncertain in maintaining

its thickness over any area; it is not workable above Bwllfa level on either side of the valley.

GREAT WESTERN COLLIERY.—This colliery is situated one mile from Newbridge; the coal at present is got from No. 3 seam to the extent of 320 tons per day, but 500 tons per day can be drawn if a demand for that quantity arose. The depth to this seam is 150 yards. There are two oval pits, both downcast, and one upcast, used exclusively for the furnace, all sunk to No. 3 seam. No. 2 pit is 16 ft. by 12 ft., No. 3 pit is 15 ft. by 10 ft., and 45 yards distant from the other. The upcast is circular in section, and about 30 yards from No. 3 pit.

WINDING AND HAULING ENGINES.—One at No. 3 pit has two 25-in. horizontal cylinders, 4-ft. stroke, direct-action, 9-ft. rope-rolls, flat wire-rope, and slide-valves. One engine at No. 2 pit pumps water at present, but has raised coal at this pit from the Forest-vach and No. 2 seams, pumping water at the same time. These seams are at present dormant, and the engine pumps water only about six hours per day. It has a 30-in. vertical cylinder, 9-ft. stroke, at each end of the beam. The beam rests on the wall of the house; a connecting-rod at the outer end of the beam communicates motion to the spur-wheel and pinions; motion reduced 2 to 1 for the rope-rolls, which are 10 ft. in diameter, and 1½ to 1 for the pumping apparatus. The latter consists of a crank, connecting-rod, and two V-bobs placed over the pit, which raise the water in two sets of pumps, lifting alternately by 9-in. and 10-in. buckets, 6-ft. stroke, four boilers for two engines. No. 3 engine draws with two bands; each carriage runs on three wire-rope guides. An underground hauling-engine, placed 400 yards along the level north-west from the bottom of the pit in No. 3 seam; has two 14-in. horizontal cylinders, 3-ft. stroke; two drums 8 ft. diameter; cog-wheels 2 to 1; one tail and main rope, 1-in. diameter; two boilers, one in use. The boilers are close to the engine; the smoke and steam are conducted from them by a separate return to the bottom of the upcast, beyond the furnace.

UNDERGROUND WORKINGS IN GREAT WESTERN.—The first branch from which coal is got commences 60 yards from the pit, proceeds about 500 yards to the rise or south-west, crossing a dip fault of 18 yards, and then along the level course 560 yards, and further to the left, where cross-headings are now going to the rise, extending about 200 yards from the level. The cross-headings are usually driven in pairs, 3 yards wide each, 10-yards pillar between them, the stalls being driven on the level course on each side. Those on the left from the main cross-heading are turned 3 yards wide at first, and gradually widened out to 8 yards, the pillar between the stalls being 12 yards of coal. Those on the right-hand, from the air-way parallel to the cross-heading, are turned the full width, 8 yards, from the first. Section of the seam taken in this district—Rock, 15 yards thick; cliff, from 3 ft. to 15 ft.; impure coal, 6 in. holing; good coal, 3 ft. 8 in.; under-clay, not hard. The holing is made in the bad coal at the top, and, when a parting occurs about 1 ft. from the bottom of the seam, the upper part is broken off by wedges, and the bottom part, 1 ft., is got also by wedging. If there be no parting, then powder is required. There is no bottom stone taken up in this district. The colliers are paid 1s. 8d. per ton for mixed coal. All the refuse that is available for filling up is that got from the holing. This is gobbed at one side of the stalls next the road, and forms an air-tight partition, by which the air is conveyed into the face of each, and returns behind it into the next stall. Canvass brattice is required in the narrow places. Naked lights are used throughout this pit. The trams for carrying coal in this district hold 7 cwts. of coal, have flanged wheels, running on bridge-rails, 20 in. gauge. These are taken out of the stalls by boys to the horse station. The horses stand not more than 12 hands; the roads are made to suit them. The trams are brought to the foot of the dip, 60 yards from the shaft, where they are placed on trolleys, two trams on each. These trolleys have tram-wheels, running on tram-plates, and by these the 7-cwts. trams are taken up the pit, and to the screen. It may be observed that the other part of the pit is laid with the now almost obsolete tram-plates, commencing at the pit, and along the level to the engine, and beyond. The trams running on this road hold 28 cwts. of coal; the wheels are 22 in. diameter.

ENGINE PLANE AND WORKINGS.—The incline plane commences at the engine; it is perfectly straight to the rise, or S. 30 W., is 1500 yards long, worked out and in by the engine, 10 trams at once, with main and tail-ropes, and two drums. The incline rises about 3 inches per yard at the bottom and at the top; in the middle of it there is about 300 yards nearly level. There are two branches to the left on the plane, and two to the right; the plane at some of these points is level. The trams are drawn into the branches by horses, the full trams brought to the same position to be started back again by the engine. One of the branches, however, has a back shunt for empty trams, and a road lower down for letting out the full ones, requiring a chain to pull back the rope, by means of the engine. The return sheave at the top of this incline is 9 ft. diameter, horizontal, about 4 ft. from the ground, and the tail-rope is supported about 4 ft. from the ground along the plane. The cross-heading is extended 400 yards beyond the sheave; at the further part the dip is the contrary way, and it again rises near the face sharply in the usual direction. There are three cross-headings in operation in this district, at the top of the incline. The trams from three cross-headings unite and join into one at certain intervals. The cross-headings have stalls on each side, on the level course, as described before. The stalls in this district are 12 yards wide, the pillars of coal between each 13 yards; they are driven 60 yards in length. The bottom is cut in the roads for height, and the roof is supported almost wholly by timber, in the absence of filling up material. As soon as the stalls are driven to their length the pillars are worked back towards the cross-heading; the pillar work is wholly dependent on timber for its support. The large trams are here filled in the stalls and brought out by horses, and on to the engine plane. A door is required at the entrance of each stall on the left, and a partition of small coal; and a similar arrangement in each stall on the right. The safety of the mine is thus dependent on each being in proper order and position. A split of air is taken to each cross-heading; at the top of each it is divided again, to circulate through the stalls on each side. Cutting coal costs 1s. 10d. per ton in these stalls. The gauge of the tram-road is 3 ft. 2 in. Supposing it were practicable to work this seam by long wall, instead of the stall and pillar system adopted and described above, the advantages which would result from the long wall plan would be greater safety, less loss of coal, less timber used, and a greater proportion of large coal obtained. To secure these results the roads should be 12 or 14 yards apart, to furnish more filling-up material, instead of, as now, 25 yards apart.

VENTILATION.—In this pit a separate split of air is apportioned to each cross-heading, which divided again circulates up and down in each stall. This air is afterwards made to traverse the old cross-headings, all of which, as a rule, are open air-courses, owing to the roof being usually a good one, and small pillars of coal being left for their support. The total air in circulation in the workings is stated to be 25,400 cubic feet per minute, and 4000 cubic feet more to the boiler fires, which does not pass over the furnace, but by a separate return to the upcast. The furnace is 9 ft. wide by 6 ft. This colliery has been in operation 18 years; during that time only one explosion has occurred of any moment, whereby two persons were burnt, though not fatally. When we reflect that a slight neglect of any single part of the system of ventilation that has been sketched would cause an accumulation of fire-damp, there is some credit due to the overlookers of the mine for care, and the observance of the ventilating arrangements. There are three men employed in this pit as firemen, four in cleaning the roads, and two in repairing and timbering the roads; these nine are all the off-hand men employed underground. There are 19 horses underground. The Cymmer Colliery explosion, which happened 14 years ago, causing the death of 114 persons, occurred in the No. 3 seam. This disaster in all probability arose from a deficiency of ventilation, and not attending to the complete circulation of air through abandoned stalls and workings. An explosion at Dinas Colliery is also recorded, previous to that at Cymmer, whereby 14 lives were lost. Since the Cymmer explosion, in 1855, two of the colliers are appointed to examine the Great Western Colliery every month, travelling the airways and abandoned workings along with the principal fireman; this they do, without any recompense from the owners of the colliery, for their own satisfaction.

DARREN-DU SEAM.—This seam is worked by Messrs. Hollwey and Co. up the hill, near to Great Western Colliery; the seam averages about 22 in. in thickness; it is worked by long wall, and produces good and clean burning house coal. The produce from the level is sent down an incline, 400 yards long, on a steep gradient to the Taff Vale Railway. The upper series of coal found here are as follows:—

	Yds.	ft.	in.
Darren-du seam	0	1	10
Pennant rock, intervening strata	120	0	0
No. 1 seam	0	2	6
Intervening strata	70	0	0
Forest vach seam	0	2	7
Intervening strata	7	0	0
No. 2 seam	0	2	6
Intervening strata	80	0	0
No. 3 seam	0	3	6

There are 130 coke ovens at Great Western Colliery using No. 3 coal; the other coals up to Darren-Du are inferior for making coke, and, excepting No. 2 seam, little used for that purpose.

EDUCATION OF MINERS.—There is no provision made by the owners of this colliery for the education of the children of the workmen. In addition to the remarks given under this head in last week's Journal, I think the address given by Sir William Armstrong in presiding over the annual meeting of the Northern Union of Mechanics' Institutes, at Newcastle recently, well worthy of recording. He expressed surprise that mechanics' institutes failed to lay hold of working men, and attributed this to the want of education amongst them. To men who can neither read nor write these institutions have no attraction. He thinks there is no question which can engage the attention of Parliament of such vital importance as that of a national system of rudimentary education; even if it went no further than the thorough teaching of reading and writing it would confer inestimable benefit upon the people. Sir William advises all large firms to do as he has done, establish mechanics' institutes, with schools attached, so that in the schools the children might learn, and in the institutes the men might find intellectual amusement and obtain culture. The amount of the schooling might be taken out of the men's wages. Comparatively few are able to read and write with ease, which prevents the advantages of mechanics' institutes being fully appreciated by those for whose benefit they are designed. M. B. GARDNER.

Sept. 21.

DŒRING'S BORING-MACHINE.

SIR,—I have just observed that Mr. Seward, the consulting engineer of the Symdde Dylluan Mine, has decided on having one of Mr. Dœring's boring-machines at that mine. Having had the superintendence of the draining of the mine about 12 years ago, and being the resident agent for over six years after, I have a perfect knowledge of the rock, and also being an eye witness to the capabilities of the machine when fully at work at the Tincroft Mines, in company with 14 other agents, whose suggestions of improvements, combined with Mr. Dœring's more practical experience, have been fully and effectually carried out, I have no hesitation in saying that Mr. Seward has taken a very wise step; and from a personal knowledge of the respectability of the firm of Messrs. De Winton and Co., he has also selected the right men to carry the object out with effect; but allow me to suggest that Mr. Seward should not be too hasty in condemning the efficiency of the machine before he gives it a perfect trial.

Mold, Sept. 21. THOMAS JULIAN.

THE SOUTH STAFFORDSHIRE AND SHROPSHIRE COAL FIELDS—No. XVI.

SIR,—In writing to a contemporary, Mr. Parton quotes a passage from a former letter of mine, in the *Mining Journal*, in which I supposed certain coal tracts within what appears to have been the estuary of denudation to have been saved from destruction by faults of depression, and asks whether others might not have been saved in a similar way. The writer will find that I admitted as much in the article he quotes from. I also made similar admissions in the paper Mr. W. W. Smyth, M.A., F.G.S., was kind enough to read for me before the British Association, at Exeter.

In assuming that the tracts in question were so saved, I availed myself of the benefit of a doubt as to the period of certain disturbances, the result of volcanic action in the neighbourhood, rather than of the supposition that the singular prolongation of the coal measures in question formed a tongue or headland stretching out into the estuary, which is the only other alternative, in case it can be shown that it was not let down below the level at which others further off were affected. The writer adds, "These facts suggest the question, will not the faults which throw in the Permian, and more especially the Bunter series of the New Red, near Kemberton, at Shifnal, Woodcote, &c., have so depressed the coal series—or, to speak more correctly, the coal series lie at such a depth as to be far out of reach of the wasting effects of denudation?" Here Mr. Parton must pardon me if I say he compares two things very dissimilar. He has evidently written in haste, and has not thought over what he had written. It is like confounding the dissolution of Monasteries in the reign of Henry VIII., with the disestablishment of the Irish Church in the reign of Victoria. I had supposed, from certain indications of igneous action in and on the borders of the Shropshire coal field, that a small patch of coal measures had been saved from denudation in previous depressions; but the faults the writer of the article refers to must have taken place not only after the Permians had been formed, but after they had in turn been denuded, and the Bunter deposited upon their wasted, water-worn, and unconformable sides. Mr. Parton must see, upon consideration, that such movements as he mentions were ages upon ages posterior to any which could have removed any portion of the coal measures out of reach of the waters of the estuary referred to, and that there is, therefore, no parallel in the case.

The problem of coal to any extent being found within the lines of the estuary, so far as they are at present defined, is one which is not likely to be put to the test, as no man in his senses would risk the outlay required in places where the Bunter and Keuper come in, swelling out their proportions, as they do only at short distances from the present coal field. I hope there may, both on the Shropshire and South Staffordshire side, be positions found where sufficient evidence can be shown to warrant searches after such coals which have escaped the ravages of the water, and I think it is highly probable that upon further investigation this will be so. I think I have before given it as my opinion that although by far the greater portion of the coal field was denuded prior to the formation of the Permians, yet that the latter were in turn, but, of course, very much later, themselves so denuded that the coal measures in places were again reached, and wasted through them. All this, of course, has to be taken into account in selecting a spot favourable for finding coals outside the old coal fields. It fortunately happens that the Permians are least thick where the prospects of finding coals is brightest; so with the Trias, and *vice versa*.

A good illustration occurs near to the Granville pits. There seems at present to be some doubt as to whether the red rocks passed through in that shaft belonged to the upper coal measures or to the Permians, but even if they were not Permians, it is well known that the Permians come close up, and had the pits been sunk on the high ground near they would have been nearly on a level at starting with that characteristic formation laid down on the map as calcareous conglomerate; and when you find that same calcareous conglomerate outside the coal field, as at Haughton, you find a good clue to the depth of the coal measures, supposing they have been fortunate enough to escape denudation at that point.

I said in my last—"I, for one, shall begin to fear that the men at the Granville Pits have serious cause to begin to look out soon for some indication of this old line of denudation to the East;" and from what I have since heard it would appear that this is so. I do not know what authority Mr. Parton has for saying, in the first paragraph of his letter of September 3—"Prof. Smyth, Mr. Lionel Brough, and others, with myself, favour the theory that the 'Symon Fault' of the Salop coal field is the effect of local denudation, which does not extend its ravages in the shape of a wide strait between the two coal fields." The sentence is a very confused one, and I should be glad if he will define what he means by the Symon Fault being "the effects of local denudation, which does not extend its ravages in the shape of a wide strait between the two coal fields." Evidently Mr. Parton misconceives the meaning of the word strait, which conveys the idea of a narrow channel connecting two seas or pieces of water with each other. In my paper before the British Association I merely used the words "estuary or strait," and all that I understood Mr. Brough to mean, when he said he did not think it was a strait, was that he did not think it was a channel between two seas, but an estuary. Moreover, it does not follow that because Mr. Smyth once held that the coals were continuous, with slight interruptions, between the Shropshire and Wolverhampton fields, that he now believes it. I have no doubt Mr. Smyth has modified his views on this point.

What I should wish of Mr. Parton, or any gentleman whom he can legitimately claim as an advocate of the theory of local denudation, is that he or they shall be a little more definite, and that they shall point out the locality within which the effects of denudation are confined. I have given him a pretty wide field, one something like 10 or 15 miles wide, and I think he is at least bound to define his locality. We know all about Stirchley and Madeley; there the effects are patent, and I have no doubt but that if we could equally follow and uncover this old coast line that Mr. Parton's local effects would become general. In fixing his locality, Mr. Parton must remember that he has got a body of water to deal with which cut away 1000 ft. of vertical strata, and had a sloping shore of 5000 ft. J. RANDALL, F.G.S.

Madeley, Salop, Sept. 22.

NOTES ON THE WARWICKSHIRE COAL FIELD.

SIR,—At this time the important question of our coal resources is being revived by the ray of sunshine proceeding from the great mass of reports, now nearly in a state of completion, on this topic. The heat gendered by this hopeful ray is quite enough to banish cold fear as to future starvation. We may, we think, with perfect resignation, trust to the bountiful provisions of Providence, and say—"Sufficient unto the day is the evil thereof." Doubtless, when the whole mass shall be opened to us, we shall, on this subject, exchange darkness of ignorance, for light of knowledge. On this interesting, and to us, as Englishmen, momentous question, we could wish that more interest could be taken in it by those individuals who are directly concerned in their daily avocations with the philosopher's stone of our age. Every mine agent, or whatever he may term himself, ought in justice to himself and his country, to be a practical geologist. A thorough acquaintance with all the interesting particulars belonging to this department of scientific lore would better fit him to perform the onerous and responsible duties belonging to his profession. The carrying out of this principle would be, in effect, to have so many special commissioners to enquire into the whole question of the economy of mining. What a boon to the country it would be to be in possession of the note-books of those in the profession of mining who carefully and scientifically noted all their observations on the mineral peculiarities and characteristics of each particular colliery or coal field. Accurate observations of this kind would result in vast economy in the winning and working of our earthly treasures. In the present letter we purpose giving a few details on the Warwickshire coal field—a coal field considered of little magnitude, and we think unjustly so. We are reading of other coal fields daily, as to their resources and probable extension, but we seldom hear aught about this one. The most detailed account is given of this coal field by the Geological Survey, published in 1859. Since that date there has been a gradual development of the coal field, and it promises to still further extend its border land underneath the red rock, so well known in the centre of England, and about which so much is said and written.

Looking at the Geological Map of this coal field, there does not appear much of the dark colour which represents the carboniferous series, or coal measures. A thin or narrow band of coal measures is shown, extending from about Polesworth, through Bedworth, and about two miles north-west of Coventry. All along this line there are to be found well-defined outcrops of the following characteristic coals:—Four-feet coal, Two-yard coal, Rider coal, slate coal, and Seven-feet coal. Besides these several valuable ironstones are seen to crop out. The most valuable are well known as white ironstone and black ironstone, each giving an average of 40 per cent. of iron.

Between Atherstone and Nuneaton, in the neighbourhood of Oldbury, a very interesting feature is noticeable in the numerous pit-holes, or ancient "bell pits," of our forefathers, running along the lines of outcrop or strike of the beds. It is here that the old charcoal smelters vainly endeavoured to find the "stone" which should turn, at least, Warwickshire coals and ironstones into gold. All that is visible of their antique handicraft in this particular is the remains of furnace slag, containing much iron. The heap in question is now clothed in Nature's green garb, and finds root for tall aspiring firs, which proudly smile on the "wreck of matter."

The protrusion of trap-rock has done much in the configuration of the coal field. Between Polesworth and Dosthill the coal seams form a synclinal axis, the coals dipping to the centre. North-west of Polesworth the measures show signs of again dipping until cut off by a fault, which brings in the Bunter of the New Red Sandstone. The fact of these beds dipping in this direction, thus forming an anticlinal axis in this direction, is an important link in the chain of evidence wanted to prove the existence of the coal beds underneath the red rocks in this direction.

The narrow band of colour which represents the exposed coal series gives us a wrong impression of the extent of this coal field. At several collieries at and near Bedworth coal is being wrought from under the part coloured Permians, and at the farthest point proved all the coals are found in their usual thickness and quality, and dip 1 in 6 unbroken under the Permians.

When the ripe time comes, a few bold speculators sinking through the Permians would develope an enormous extent of productive measures, and so surely as we are writing this, so surely will that needful time soon come in the history of our nation. Our next will contain a more detailed account of the coals and ironstones peculiar to this field, as to their character for economic purposes, extent, and other particulars.—*Willenhall, Sept.* 21. T. PARTON, F.G.S.

PATENTS OR NO PATENTS—No II.

MR. MACFIE'S ARGUMENTS DISPROVED.

SIR,—A further point of objection to patents which Mr. Macfie relies upon is based upon the fact that the patentee has the power to keep the whole trade in the patented article in his own hands for the term of his patent. This is an objection that is not a new one, but, as far as I am aware, it has never received that consideration to which it is entitled. Of course, if patents confer a proprietary right we must expect to find that exclusive right to profits is a main incident of patents. At the same time, the law, as set forth in the Statute of Monopolies, says that should any patent be found to be "to the hurt of trade, or generally inconvenient," or, as a proviso in the Letters Patent puts it, if the grant should be found "prejudicial or inconvenient to Her Majesty's subjects in general," such patent is to be put an end to by law. This, I believe, to be a wise and salutary provision, and should be ready to aid Mr. Macfie, or anyone else, in giving practical effect to it, which I consider might be done in the way I have pointed out in my Treatise on the Law of Patents, recently reviewed by you—that is, by giving vitality to that clause in the patent which allows the Privy Council to set aside any patent on such grounds. On this matter, however, Mr. Macfie confounds two distinct issues; he devotes much time [see especially pp. 51, 52, 53 of his work] to the endeavour to prove that all patents are prejudicial and inconvenient to manufacturers, and he makes it an inevitable and necessary consequence that they are, therefore, to the hurt of trade, and prejudicial to the public in general. But I venture to affirm that this consequence does not necessarily follow, and that such consequence really flows from a distinct issue. For so long as one manufacturer is fully supplying the public demand for the patented article on fairly reasonable terms there is "no hurt of trade," unless we are to take that view of this expression which Mr. Macfie countenances—that when an improvement comes into competition with an old plan the competition hurts those who carry on business on the old plan, hence it hurts trade, a line of argument which must send us back to the days of commercial protection, as the introduction and purchase of foreign goods must always hurt the trade of those who carry on the home manufacture of the same kind of goods; in fact, in all affairs of life the new is always pushing the old and *effete* out of existence. In short, Mr. Macfie's view of the matter is this—whereas, by the Patent Law, patentees are protected against piratical manufacturers, the manufacturers' property should be, by law, protected against patentee improvers.

Nor can it be truly said that the keeping of the whole trade, as regards a patented invention, in one manufacturer's hands is prejudical or inconvenient to Her Majesty's subjects in general, for unless

the supply be behind the demand no patent can be said to operate prejudicially to the public, or to the limit of trade within the meaning of the law. And when this prejudicial action does occur, even in that case the remedy would seem to be not the repeal of the patent, but the compelling of the patentee to grant licenses on reasonable terms. In point of fact, this objection to patents is a mere bugbear, for no one but a madman would ever seek to keep a trade entirely in his own hands when he finds it grows too big for him, and he can obtain royalty payments by granting licenses.

As to the dog in the manger system adopted by some stupid people, who not being able to work patents themselves, yet prohibit others from working them unless on exhorbitant terms, that kind of abuse would also be put an end to, by compelling a patentee to grant licenses to applicants (who should be bound to work the patents) on reasonable terms, to be settled by arbitration.

I confess I am inclined to go to this extent also with Mr. Macfie in taking measures on behalf of manufacturers, that whenever they are willing to subscribe a good round sum to buy up a patentee's rights (which they might possibly sometimes do, for they do now subscribe large sums to defend infringements—witness Bovill's case), that then, still leaving the patentee free to trade without any exclusive right, the patentee should be compelled to surrender his right on the payment of a certain sum, provided it be in amount something like a fair compensation payment, the decision on which should be left to arbitrators or assessors, appointed with the sanction of the patentee. Mr. Macfie expresses himself disappointed at finding the *Mining Journal* against his propositions; if he is not determined to have the bond, and nothing else, I can say for myself that I should be happy to give him any assistance in endeavouring to obtain the prevention of the improper use of patents by patentees, though I cannot advocate the abolition of patents. F. W. CAMPIN.

Gray's Inn, Sept. 22.

THE PATENT LAWS.—A correspondent ("Kaolin") thus writes to the *Liverpool Albion*:—"Mr. Macfie is particularly unfortunate in his illustrations. The Bessemer portion of the Mersey Works is not the only part that is closed, and Bessmer's patent rights had nothing whatever to do with that section. The Mersey Company had only to pay the same royalty as other licencees, and if they could not compete with the few other makers now licenced I cannot see how they will be in a better position on the expiration of the patent next year, when exposed to the unlimited competition of the whole iron trade. He is, perhaps, more unfortunate in taking Bessemer as an example against the Patent Laws. Bessemer's steel invention created a new industry in the country. I am unable to get at the exact quantity of Bessemer steel that has been exported from this country in the shape of rails, tyres, plates, bars, &c., but I believe I am within the mark in putting it down at 250,000 to 300,000 tons during the term of the patent, which has produced at port of shipment an average price of about 14*l.* per ton, making a total money value of 3,500,000*l.* to 4,200,000*l.* net gain to this country by the invention, less only a very small amount (perhaps 250,000*l.*), which this country has had to pay for small quantities of spiegleisen, which it was necessary to import from Germany. A further collateral advantage accruing from this process is that its manufacture in America and the continent of Europe has required large quantities of English hematite pig-iron, which has been a large gain to our exchanges, and clear profit to the nation. It may also incidentally be remarked that Mr. Bessemer, previously to taking out his famous steel patent (which is about shortly to expire and become the property of the public), carried on a secret manufacture of bronze powder, which is understood to be very lucrative. He has enjoyed that for a much longer term than that allowed for a patent, and he and his successors may enjoy it for a century to come. I ask is it better for the general welfare that a patent should be granted for a limited term, on condition that the invention be fully described and become public property at the end of 14 years, or that the inventor should be driven to secret manufacture, which may be lost at his death, to the great detriment of the public interest? The two instances which I have given will, I think, answer that question. There may be anomalies and hardships in the present Patent Laws. Improve them if you will, but do not kill the goose that lays the golden eggs by abolishing them altogether."

ABOLITION OF PATENT MONOPOLIES.

SIR,—I have read with much interest the correspondence, more especially your articles, on the above question, which, it appears to me, resolves itself into a nutshell, and may be solved by the two following questions—What would society be without Watt's engine? And would Boulton have expended a shilling to its maturity had he not been protected by a patent law?

There is also another point of view which Mr. Macfie and other supporters of the abolition of *our* patent laws appear to have lost sight of, and that is that patent laws are not national, but international; and England cannot, without infamy, think of conferring on her manufacturers the advantage of the free use of patents taken out in other countries, unless other nations agree to put their manufacturers on an equally advantageous footing. The proposition is too monstrous to deserve the slightest consideration, and the patent laws, bad and unjust as they are towards poor inventors, such as Watt, who by the merest chance fell into the hands of an honourable man, must be maintained as they are, or undergo thorough reformation.

When Mr. Cobden was agitating the free trade doctrine, I told him that unless England became a self-feeding nation, in proportion as other countries were instructed in our mechanical appliances, they would beat us in the race of competition, from the fact that labour was obtainable at half the price it was procurable here, and now that my predictions are verified, and our excess of imports over exports has attained the very respectable proportion of 116,000,000*l.* a-year, attention from the fact is to be diverted by the patent law question, as if poor inventors were the cause of all the mischief of tinkering, or legislating without a directing principle.

The cards may be shuffled again and again, but trumps are sure to turn up, and Mr. C. W. Siemens, in his inaugural address—"Mechanical Science"—at the late meeting of the British Association, has sealed the fate of the theory of heat, by the very natural deduction that if heat be absorbed during the conversion of water into steam, it must be gained during the formation of ice; and as I am not versed in the mysteries of science, I may be pardoned for repeating his words. He says:—

"In changing, for example, a pound of water from the liquid into the gaseous state, a given number of units are required that may be produced by combustion of coal or by the expenditure of force; but in changing the same pound of water into ice, heat is not lost but gained in the operation, which heat *must be traceable* to another part of the machine, either as sensible heat or as developed force."

As I have said, I am not learned in science, and am, therefore, unable to define what is meant by "thus a pound of ordinary coal is capable of producing 12,000 (Fahrenheit) units of heat, which equal 2,240,000 foot-lbs. or units of force;" but in a letter that I addressed to the directors of the Royal Polytechnic Institution, so far back as Aug. 19, 1845, soliciting the use of their hydro-electrical boiler to the demonstration of a principle, I observe:—

"In asking of you this favour it is, perhaps, necessary that I should show some reason for soliciting it. You are, of course, aware that the electric spark will *cause the combination* of hydrogen and oxygen, that flame absorbs electricity, and that during the compression of the steam generated in your hydro-electrical machine great quantities of electric fluid fly *to* the boiler.

"It is clear, then, that electricity is absorbed during the condensation of vapour, and we know that water contains it in great quantities; and as electricity is absorbed largely during the formation of water and of carbonic acid, it appears to me evident that instead of what is commonly called heat, or caloric, being imparted to the water during the formation of vapour, that electricity must be extracted from the water, and that the steam is the natural consequence of the water being deprived of a portion of its electricity, or of the power that holds its atoms together.

"I propose placing two bars of iron, of about 1 foot in length and 1 inch in diameter, in the furnace of your boiler, and when taken out in a red state to insulate them both at the same distance from the apparatus, but to connect one of them with the boiler and the ground, so that the fluid in its passage to the boiler shall pass through the bar. If my views be correct, the bar through which the electricity will pass should cool much quicker than the one insulated, as it will have imparted to it the electricity it will have lost in the furnace, at a quicker rate than the other, that will be merely absorbing it from the air, and that the effect must be, in fact, to a certain extent *analogous to the action of water on the bar*, since I conceive that, in this case, all that the bar does is to abstract from the water its electricity in the same way as does the fire."

Whether I am right or wrong, the above, which was written twenty-four years ago, is, at least, free from all ambiguity, and guided by the same train of reasoning, I came to the conclusion that ice was crystallised water, the electricity of crystallisation being obtained from the atmosphere, the correctness of which conclusion I satisfactorily demonstrated, as will be seen on reference to the papers of 1849, by "S.;" am I to be told, then, that if on these principles I shall produce a furnace that will economise one-quarter or one-half of the fuel now consumed in the generation of steam, I must depend on the honour or justice of the public for my reward for a long life of labour? In 1848 I gave to the Government my plans for the ventilation of the House of Commons, and that same year I was officially debarred from promotion in the public service, in 1851 dismissed without enquiry; nevertheless, not very long afterwards, Dr. Reid, the fallacies of whose principles I demonstrated, was dismissed, and Mr. Goldsworthy Gurney appointed in his stead, and during his direction of affairs my plans were surreptitiously applied; to all which Mr. Macfie is, no doubt, a stranger, but, if he will take the trouble to inform himself, the facts will, I think, convert him from a demolisher to a reformer of our patent laws. Assuredly the labour of the brain must count for something.

In 1848 I also made public my system for the drainage of the metropolis, by the adoption of which in six months London might have been relieved of all its filth, and the sewers ventilated, for less than 500,000*l.*; but the Board of Health were then busy in wasting the public money in the futile attempt to dispose of the sewage of towns by irrigation, and certain important personages were eager for office; the Metropolitan Board was formed, 5,000,000*l.* have been expended, the drainage is not yet completed, and the Thames remains the receptacle of the filth, a part of which only is fast choking up the river. Boards of Health have been created in other towns, and injunctions in Chancery have become necessary to stop their progress in the nuisance-creation art; and the want of food, export of gold for its purchase, and consequent loss of trade from its high price, the natural results of the waste of a highly fertilising material, have brought on poor inventors the ire of those who have had a finger in the created mess.

In reference to my letter which appeared in the Supplement to the Journal of the 18th inst., on the sand and gravel formations, I inclose for your inspection a piece of paper, giving an actual representation of some layers in a gravel pit to the north of this.

Fawley, Sept. 20. FRANKLIN COXWORTHY,
Author of "Electrical Condition."

THE MINERAL WEALTH OF PORTUGAL.

SIR,—This week I purpose giving some account of the best of the iron mines which belonged to the late Portugal Iron and Coal Company. I must, however, premise that their iron works, being established at Marinha Grande, on the borders of the Pinhal del Rey, all remarks relating to roads and distance will apply to the roads situate between the several localities and that town. That the company in question possessed some very valuable iron mines there can be no doubt; and, although it may appear to be a paradox, still I believe it to be the fact that the very richness of the outcrops, and the apparently large quantity of serviceable ore on the surface, that "only wanted shovelling into carts" (vide the first reports), was the primary cause of ruin to the undertaking, as many have been ruined before, inasmuch as this promise of an abundant and cheap supply of ore induced the directors to commence operations with an insufficiency of subscribed capital. In the district are to be found almost every class of iron ore, and with one exception all remarkably free from deleterious substances. Some of the concessions were found to be practically useless, on account of the great distance from the works; others, again, which were reported to be most valuable as sources of ore, were on investigation proved to be worthless, the soil only being stained from having pieces of hematite mixed with it; and anyone having a practical acquaintance with this ore will know how deceptive appearances are where it is concerned. The inaccessible concessions were Serra Ventoza, Mendiga, and Alquidao. Serra Ventoza, which is situated on the side of a mountain in the range known as the Backbone of Portugal (this range, as far as I am acquainted with it, consists of the oolite or jurassic limestone) is 16 miles from Marinha Grande; the road up to it is simply execrable, it being absolutely necessary to take mules at Porto do Moz, and even then the visitor will have to climb the last part on foot. The lode itself was reported to be "a powerful, well developed lode of hematite." No work was ever done on it beyond making a hole 3 ft. deep to extract some samples, which yielded 71 per cent. of peroxide of iron, and 12 per cent. of lime. A subsequent report on this place says—"For every ton of ore from 50 to 60 tons or more of limestone must be excavated, and the ore separated from it; so that every piece extracted would have to be hand-picked." This I do not agree with, but give it, so that your readers may be in possession of all the information I possess.

Mendega Mine is on the top of a neighbouring mountain, the road being even worse than that to Serra Ventoza, consists of a nearly vertical lode of considerable width, which has been traced for five or six miles across the mountains; the contents of the lode are composed of a breccia of fragments of limestone, cemented together with oxide of iron. Alqueidao, 16 miles from Marinha Grande, presents some features of interest from the very peculiar nature of the deposit; nearly on the top of the hill of Alqueidao are some large pieces of iron ore, which lie in a somewhat straight line, but whether they are *in situ*, or only erratic, I cannot say, but I strongly suspect the latter; the whole of the hill side is strewn with fragments of ore, and as may be expected the soil is strongly impregnated with oxide of iron. It is assumed that there were Moorish or Roman works in the neighbourhood, from the quantity of scoria found scattered about, but I do not think any remains of iron works, or other buildings, have yet been found, although there are sundry ridges and furrows which are evidently not natural, but they may just as well have been made for entrenchments as iron mines, and the physical formation of the country favours this supposition. These three places were entirely neglected, it being out of the question to attempt to work them, as it would have required an enormous outlay for making new roads and repairing old ones, moreover there was a much better supply to be obtained nearer to the works, but although they were of no use to the late company, they would be well worth the attention of capitalists in the event of the Portuguese Government carrying out their intention of making a railway from Pombal to Leiria, and thence to Porto do Moz, *via* Batalha.

BATALHA, CHAO PRETO.—Iron ore occurs in comparative abundance as nodules on the surface, and in bands in the strata. The nodules are scattered all over, and vary in size from a few ounces to some pounds weight. When broken they present the usual laminated structure, and give 43 per cent. of iron. The other variety which is found regularly stratified is a very serviceable ore; it occurs in two beds, separated by a thin layer of sandstone. These beds were found well developed in a shallow cutting which has been made in constructing the road, but on account of the distance from the mine, and the refusal of the owner of the soil—or rather, I should say, the owner of a moiety of a small field—to sell his interest, work was not commenced here till shortly before the company suspended operations. The ore was remarkably good, the upper bed giving by assay 33·8 per cent. of metallic iron and the lower one 76·5, Fe_2O_3 and 6·6 H_2O (combined); the remainder was principally lime at first, but at a little depth it became mixed with pyrites; although there was no reason to suppose that this defect was more than local, as the magnetic ore I mentioned being found in No. 2 level of the coal workings, and which was probably a part of this deposit, was perfectly free from anything of the sort.

I had intended to have concluded the subject this week, but I find that it will exceed the limits of a letter to give a full account of the other works in the concessions; and, as the facts to be noticed may raise questions of considerable interest, I should be sorry not to be able to do them justice, and, therefore, reserve it for another occasion.

E. HEYDELBACH DAVIS, F.C.S., F.G.S.

West Brompton, Sept. 22.

THE MINERAL WEALTH OF PORTUGAL.

SIR,—Having been for the last fortnight travelling on the Continent I did not see your impression of the 11th, containing two letters, one from Mr. Davis the other from Mr. Lintern. Taking the last first, I cannot compliment Mr. Lintern on the mare's nest he has found in some "tile-like moulds" of patent fuel, neither can I afford him any new light to see what I have seen; it is clear that he has not searched the coast so minutely as he would have you believe, because what I saw, and described in my last letter to your Journal, could not have failed to impress the most casual observer. Mr. Lintern surely does not pretend to say there is *no* coal shown in the cliffs near to Marinha Grande, or that there is no coal formation close to Leiria, if he does it is impossible for me to help him. Now, about what he calls my "Patent Fuel;" I never patented, either in this country or Portugal, the system I have adopted with success in Ireland to render peat fuel or the inferior descriptions of coal serviceable; suffice it to say that Mr. Lintern saw none of mine in the Portugal Coal and Iron Company's office in Leiria, for having manufactured it myself I took it with me to Lisbon to experiment upon, which I did, and on referring to my note-books of these experiments I find the following:—

"Block weighing 5½ kilos.; this was broken, and half placed in the furnace of a Cornish boiler, where it burned well, with an intense heat for 1½ hour, and was only just consumed, the residue being mere ash."

Other blocks were also tried, and the late Mr. Powles expressed himself perfectly satisfied with the experiments, as did also Mr. Croft and Mr. Freitas (two of the local directors of the company). I found I could make this fuel at a most trifling cost, which, when delivered at Lisbon, could be disposed of far more advantageously than English coal for the mail steamers which enter the Tagus for supplies; but what I hinted at by speaking of Mr. Powles's management was the absurdly low estimate he placed on other people's services as compared with his own, a proposition I could not for one accede to; and, although he made me an offer to work the fuel business of the Portugal Iron and Coal Company, it was such an one as no professional man could have accepted with any regard for himself or his profession. This is my only complaint against Mr. Powles, and I have heard that I am by no means singular in my experience of his management of companies. Now, as regards Mr. Lintern's offer to me, I consider that it is quite in keeping with the rest of his letter, which is an arrogant assumption of importance. He knows as well as any of your readers that the company which he formerly served is in process of liquidation; the assignees, therefore, being the liquidators, of which he does not appear to be one, how, then, can he guarantee and make the offer of a property which in no way or shape belongs to him, and over which the liquidators would keep a very sharp look out that he in no way interfered with the disposal of it? Your correspondent must remember the old adage, that "They who live in glass houses should never throw stones." How, then, can he expect that I should refrain from expressing an opinion of his share of the management of this unfortunate concern, his own specimen of "patent fuel" bearing date "later in the year 1865," nevertheless notwithstanding.

Mr. Davis, in his communication to you, is very precise as to the mode of access to Leiria, and so forth, but I really think he can hardly be serious when he says that he thinks the district is not worth working. Why, Sir, in the outcrops alone, which he is so careful to describe, there are thousands of tons of lignite and coal which, if treated in a proper manner, can be manufactured into a marketable commodity, although I am not in a position at present to entertain the offer so gratuitously made by your correspondent, Mr. Lintern.—*London, Sept.* 22. CHARLES B. KING, C.E.

[For remainder of Original Correspondence, see this day's Journal.]

FOREIGN MINING AND METALLURGY.

It appears from the report just presented to the shareholders in the Styrum Siderurgical Company that the production effected by the company in 1868-9 presented a sensible increase upon the production of 1867-8. As the price of raw material did not advance in a corresponding proportion, a higher net profit is consequently anticipated in the current year. The dividend actually paid for 1867-8 was at the rate of 8½ per cent. per annum. The company's establishments are principally employed in the manufacture of plates, iron in bars, and bridge material. It appears that the works of the Lueneburg Siderurgical Company, which have been in working 25 years, in 1868 employed 238 workmen.

A circumstance of some significance has occurred in the district of the Haute-Marne (France); an establishment for producing iron finds itself so overcharged with orders that it has had to transfer some of its business to other works of the group. If forgemasters are obliged to have recourse to their competitors to execute all the orders which are addressed to them, it is evident that work is very abundant, and that the position of the iron trade is improving more and more. The prefect of the Haute-Marne, in a report addressed to the Council-General of that department, says:—"Upon the whole, the state of mining and metallurgical industry is now satisfactory, except for some furnaces devoted to the production of refining pig, which cannot place their products except at lower terms. The foundries are now in a state of great activity; their selling prices are satisfactory, and their production will probably be considerably larger in 1869 than it has been for many years past. The rolling mills also witness an increase in the number and importance of their orders, while prices are sufficiently high." The prefect adds that if metallurgical industry has thus revived in the Haute-Marne, the result is due to a regulation of March 9, 1868, with reference to warrants. It is ludicrous to see how official instincts have restricted the vision of the prefect when he makes this remark; the real fact is that the improvement noticeable in the French metallurgical market is due in great part to the increased demand for railway iron, which has sprung up all over the continent of Europe, and also in the New World. Rolled iron, from coke-made pig, is quoted at 8*l.* 4*s.* per ton; special iron at 8*l.* per ton; sheets at 9*l.* 8*s.* per ton, first class. Machine No. 20, coke-made, has brought 8*l.* 16*s.* per ton, and mixed ditto 9*l.* 12*s.* per ton. Business in refining pig is not very active (as stated in the prefect's report); quotations are to some extent nominal for charcoal-made at 4*l.* 8*s.* per ton; and at 3*l.* 8*s.* 10*d.* to 3*l.* 10*s.* 6*d.* per ton for mixed ditto. The Froucles rolling mill is now again in operation; the repairs were not completed until the 15th inst. Drought has reduced some works quite to hard extremities, by compelling them to remain almost idle; among the works in this state may be mentioned those of Clos-mortier and Marnaval. Fine pig has become scarce in the Franche-Comté district, and prices have in consequence been tending upwards. The advance will be limited, of course, by the prices current for the pig of the South of France, which for a great number of articles has definitively taken the place of the fine pig of the Comté group. The rise will also be checked by the invasion of the French market by Swedish iron. The annexed table shows the average selling price per ton of first class coke-made iron during the decennial period embraced between 1859 and 1868 at the depôts of the principal works on the markets of Paris and Lyons:—

Years.	Paris.	Lyons.	Years.	Paris.	Lyons.
1859	£10 10 0	—	1864	£ 8 15 0	£8 5 0
1860	10 2 0	£9 1 0	1865	8 3 9	8 2 6
1861	9 10 0	9 5 0	1866	8 8 0	7 18 0
1862	9 18 0	9 17 0	1867	8 1 0	7 10 0
1863	9 3 0	8 16 0	1868	8 14 6	7 16 0

It will be seen that from 1860 to 1867 the selling price, at Lyons was constantly below that current at Paris, and that it was only last year that Lyons quotations became higher than those of Paris. It may be interesting to add another table, showing the production of rails in France during the last ten years, and their average price per ton:—

Years.	Tons.	Price per ton.	Years.	Tons.	Price per ton.
1859	101,426	£10 8 0	1864	215,983	£ 7 8 0
1860	121,438	8 8 0	1865	184,131	7 8 0
1861	164,371	8 12 0	1866	159,061	7 12 0
1862	216,175	8 8 0	1867	154,351	7 8 0
1863	226,948	7 12 0	1868	202,204	7 2 0

The production has thus doubled in ten years, while, comparing the average price of 1868 with that for 1859, we have a decline of no less than 3*l.* 6*s.* per ton. The Longwy group has another furnace in activity, that of Cons-la-Grandville, having been lighted two months since; it is turning out grey pig. The minerals of the Pulventeux Concession are employed with a mixture of the alluvial minerals of San Pancré and Aumetz, and with the addition of the alluvial minerals of Athus. The St. Etienne Collieries Company will pay, Oct. 16, a dividend of 4*s.* per share on account in respect to profits realised during 1869. The Loire Mines Company will pay on the same day a dividend of 3*s.* 2*d.* per share on account in respect to profits realised during 1869.

The French copper markets have not been very animated. At Havre, Chilian in bars has been feeble at 69*l.* 8*s.* per ton, Paris conditions. At Paris, Chilian in bars has been quoted by continuation at 69*l.* 12*s.* per ton; ditto in ingots, 74*l.* 10*s.* per ton; ditto Corocoro minerals, pure standard, 72*l.* per ton. At Marseilles, Toka in warehouse has made 72*l.* per ton; Spanish, 70*l.* per ton for consumption; refined Chilian and Peruvian, 74*l.*; rolled red copper for sheathing, 82*l.*; yellow ditto, 78*l.* per ton. The German copper markets have been generally quiet, and on most of them the article has remained without change. At Hamburg purchasers display a great reserve, and prices have been, to a great extent, nominal. At Rotterdam, Russian has made 51 fls.; and Drontheim, 50 to 52 fls. At Havre business has been very restricted in tin; Banca has made 114*l.* to 117*l.*; and Peruvian, 100*l.* to 104*l.* per ton; this latter quotation is, however, to a great extent, nominal. At Paris the price of tin displays no material variation. The German tin markets remain without any great movement. The article has hardened, however, on the Dutch markets; Banca was last quoted at Rotterdam at 78¾ fls., but at this price there were few buyers. Billiton has become scarcer at Rotterdam; 77¾ fls. to 78 fls. had been paid for disposable. At Amsterdam disposeable Banca had brought 78¾ fls. to 79 fls.; in disposeable Billiton some business has been done at 78 fls. The result of the approaching sale of the Society of Commerce will depend materially upon the quantities which may have arrived during the current week. Nothing striking has occurred in the lead trade.

Certain attempts which have been made in the Charleroi basin to establish an advance in coal have thus far completely failed. This check has surprised no one—in fact, the efforts made by a few persons in the direction of an advance are thus far generally blamed by the mass of extractors. Stocks are still numerous and important, and although deliveries by railway are numerous, those by water show little activity. The information which comes to hand from the various Belgian metallurgical centres does not present any special features of interest. The state of affairs may be said to remain the same. The Eastern of France Railway Company has just come to an understanding with the Great Central Belgian Railway Company with reference to the conveyance of Belgian metallurgical products to Fumay, Revin, Delville, Montherme, Braux, Nouzon, and Charleville. Deliveries were formerly made through the medium of a customs agent, and were subject to re-inscription at the frontiers; hence resulted delays and an increase in transport expenses. The Monceau Blast Furnace Company will pay, Oct 1, a dividend of 5 per cent. on account in respect to profits realised during the current year.

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